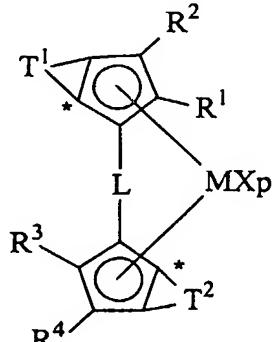


## Claims

1. A process for preparing isotactic 1-butene copolymers containing up to 30% by mol of units derived from one or more alpha olefins of formula  $\text{CH}_2=\text{CHZ}$ , wherein Z is a  $\text{C}_3\text{-C}_{20}$  hydrocarbon group comprising contacting 1-butene and one or more of said alpha-olefins, under polymerization conditions, in the presence of a catalyst system obtainable by contacting:

a) at least a metallocene compound of formula (I)



(I)

wherein

M is a transition metal belonging to group 3, 4, 5, 6 or to the lanthanide or actinide groups in the Periodic Table of the Elements;

p is an integer from 0 to 3, being equal to the formal oxidation state of the metal M minus 2;

X, equal to or different from each other, are hydrogen atoms, halogen atoms, or R, OR,  $\text{OSO}_2\text{CF}_3$ , OCOR, SR,  $\text{NR}_2$  or  $\text{PR}_2$  groups, wherein R is a linear or branched, saturated or unsaturated  $\text{C}_1\text{-C}_{20}$  alkyl,  $\text{C}_3\text{-C}_{20}$  cycloalkyl,  $\text{C}_6\text{-C}_{20}$  aryl,  $\text{C}_7\text{-C}_{20}$  alkylaryl or  $\text{C}_7\text{-C}_{20}$  arylalkyl radical, optionally containing heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements; or two X can optionally form a substituted or unsubstituted butadienyl radical or a OR'O group wherein R' is a divalent radical selected from  $\text{C}_1\text{-C}_{20}$  alkylidene,  $\text{C}_6\text{-C}_{40}$  arylidene,  $\text{C}_7\text{-C}_{40}$  alkylarylidene and  $\text{C}_7\text{-C}_{40}$  arylalkylidene radicals;

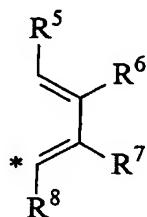
L is a divalent bridging group selected from  $\text{C}_1\text{-C}_{20}$  alkylidene,  $\text{C}_3\text{-C}_{20}$  cycloalkylidene,  $\text{C}_6\text{-C}_{20}$  arylidene,  $\text{C}_7\text{-C}_{20}$  alkylarylidene, and  $\text{C}_7\text{-C}_{20}$  arylalkylidene radicals optionally containing heteroatoms belonging to groups 13-

17 of the Periodic Table of the Elements, and silylidene radical containing up to 5 silicon atoms;

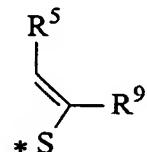
$R^1$  and  $R^3$ , equal to or different from each other, are linear or branched, saturated or unsaturated  $C_1-C_{20}$  alkyl,  $C_3-C_{20}$  cycloalkyl,  $C_6-C_{20}$  aryl,  $C_7-C_{20}$  alkylaryl or  $C_7-C_{20}$  arylalkyl radicals, optionally containing heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements;

$R^2$  and  $R^4$ , equal to or different from each other, are hydrogen atoms or linear or branched, saturated or unsaturated  $C_1-C_{20}$  alkyl,  $C_3-C_{20}$  cycloalkyl,  $C_6-C_{20}$  aryl,  $C_7-C_{20}$  alkylaryl or  $C_7-C_{20}$  arylalkyl radicals, optionally containing heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements;

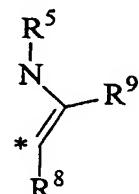
$T^1$  and  $T^2$ , equal to or different from each other are a moiety of formula (II), (III) or (IV):



(II)



(III)



(IV)

wherein: the atom marked with the \* is bound to the atom marked with the same symbol bonds in formula (I);

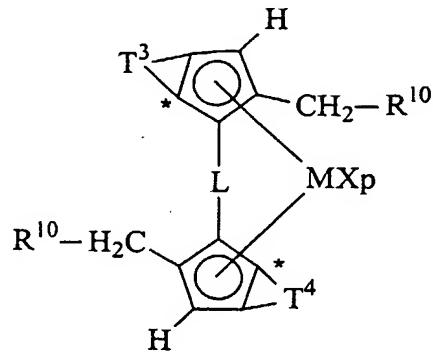
$R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$  and  $R^9$ , equal to or different from each other, are hydrogen atoms, or a linear or branched saturated or unsaturated  $C_1-C_{20}$ -alkyl,  $C_3-C_{20}$ -cycloalkyl,  $C_6-C_{40}$ -aryl,  $C_7-C_{40}$ -alkylaryl,  $C_7-C_{40}$ -arylalkyl radicals, optionally containing heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements;

$R^6$  and  $R^7$  can also join to form a saturated or unsaturated condensed 5 to 7 membered ring optionally containing heteroatoms belonging to groups 13-16 of the Periodic Table of the Elements; and

- b) at least an alumoxane or a compound able to form an alkylmetallocene cation.
- 2 The process according to claim 1 wherein the catalyst system further comprises organo aluminum compound.
- 3 The process according to claim 1 or 2 wherein in the compound of formula (I) M is titanium, zirconium or hafnium; X is a hydrogen atom, a halogen atom or a R group; L is selected from the group consisting of is  $Si(CH_3)_2$ ,  $SiPh_2$ ,  $SiPhMe$ ,  $SiMe(SiMe_3)$ ,  $CH_2$ ,

$(\text{CH}_2)_2$ ,  $(\text{CH}_2)_3$  and  $\text{C}(\text{CH}_3)_2$  and  $\text{R}^9$  is a hydrogen atom or a linear or branched saturated or unsaturated  $\text{C}_1\text{-C}_{20}$ -alkyl radical.

4 The process according to anyone of claims 1 to 3 wherein the metallocene compound has formula (V):

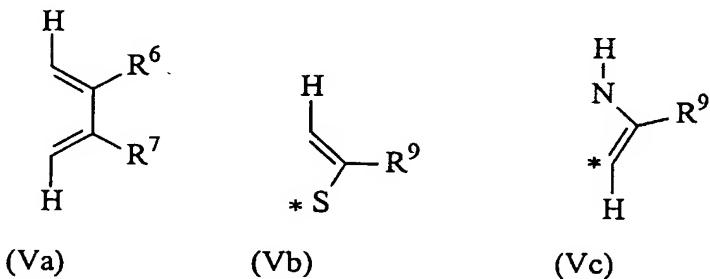


(V)

wherein M, L, X and p have the same meaning as in claim 1;

$\text{R}^{10}$ , equal to or different from each other, are hydrogen atoms, or linear or branched saturated or unsaturated  $\text{C}_1\text{-C}_{19}$ -alkyl,  $\text{C}_3\text{-C}_{19}$ -cycloalkyl,  $\text{C}_6\text{-C}_{19}$ -aryl,  $\text{C}_7\text{-C}_{19}$ -alkylaryl,  $\text{C}_7\text{-C}_{19}$ -arylalkyl radicals, optionally containing heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements;

$\text{T}^3$  and  $\text{T}^4$ , equal to or different from each other are moieties of formula (Va), (Vb) or (Vc):



(Va)

(Vb)

(Vc)

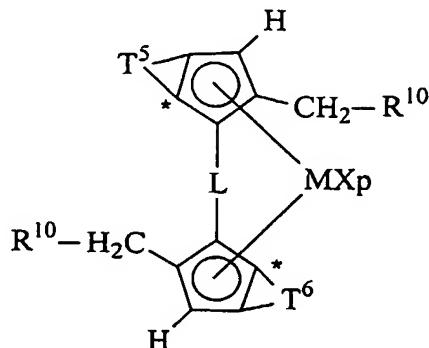
wherein: the atom marked with the symbol \* is bound to the atom marked with the same symbol in formula (V);

$\text{R}^6$ ,  $\text{R}^7$  and  $\text{R}^9$  have the same meaning as in claim 1.

5 The process according to claim 4 wherein in the compound of formula (V)  $\text{R}^{10}$  is a hydrogen atom or a  $\text{C}_1\text{-C}_{19}$ -alkyl radical;  $\text{R}^6$ ,  $\text{R}^7$  are hydrogen atoms or linear or branched saturated or unsaturated  $\text{C}_1\text{-C}_{20}$ -alkyl radicals, or they can form a saturated or unsaturated 5 or 6 membered ring optionally containing heteroatoms heteroatoms

belonging to groups 13-16 of the Periodic Table of the Elements; and  $R^9$  is a linear or branched saturated or unsaturated  $C_1$ - $C_{20}$ -alkyl radical.

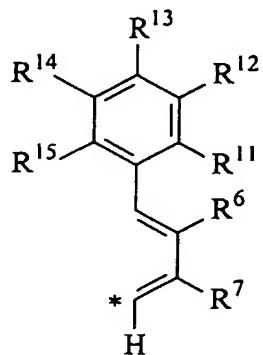
6 The process according to anyone of claims 1 to 3 wherein the metallocene compound has formula (VI):



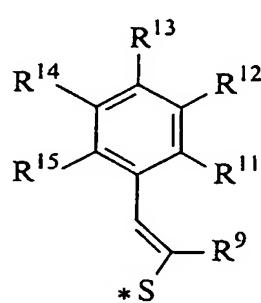
(VI)

wherein  $M$ ,  $L$ ,  $X$  and  $p$  have the same meaning as in claim 1 and  $R^{10}$ , equal to or different from each other, are hydrogen atoms, or linear or branched saturated or unsaturated  $C_1$ - $C_{19}$ -alkyl,  $C_3$ - $C_{19}$ -cycloalkyl,  $C_6$ - $C_{19}$ -aryl,  $C_7$ - $C_{19}$ -alkylaryl,  $C_7$ - $C_{19}$ -arylalkyl radicals, optionally containing heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements;

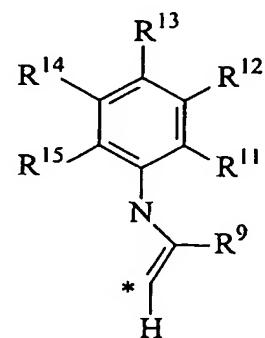
$T^5$  and  $T^6$ , equal to or different from each other are a moieties of formula (VIa), (VIb) or (VIc):



(VIa)



(VIb)



(VIc)

wherein: the atom marked with the symbol \* is bound to the atom marked with the same symbol in formula (VI);

$R^6$ ,  $R^7$  and  $R^9$ , have the same meaning as in claim 1;

$R^{11}$ ,  $R^{12}$ ,  $R^{13}$ ,  $R^{14}$ , and  $R^{15}$ , equal to or different from each other, are hydrogen atoms or linear or branched saturated or unsaturated  $C_1$ - $C_{20}$ -alkyl,  $C_3$ - $C_{20}$ -cycloalkyl,  $C_6$ - $C_{20}$ -aryl,  $C_7$ - $C_{20}$ -alkylaryl,  $C_7$ - $C_{20}$ -arylalkyl radicals, optionally containing heteroatoms belonging to groups 13-17 of the Periodic Table of the Elements, or two adjacent groups can form together a saturated or unsaturated condensed 5 or 6 membered ring optionally containing heteroatoms belonging to groups 13-16 of the Periodic Table of the Elements.

- 7 The process according to claim 6 wherein  $R^6$ ,  $R^7$  are hydrogen atoms or linear or branched saturated or unsaturated  $C_1$ - $C_{20}$ -alkyl radicals; or they can form a saturated or unsaturated 5 or 6 membered ring optionally containing heteroatoms belonging to groups 13-16 of the Periodic Table of the Elements;  $R^9$  is a hydrogen atom or a linear or branched saturated or unsaturated  $C_1$ - $C_{20}$ -alkyl radical;  $R^{11}$  is a  $C_1$ - $C_{20}$ -alkyl radical;  $R^{14}$  is a hydrogen atom or a  $C_1$ - $C_{20}$ -alkyl radical; and  $R^{12}$ ,  $R^{13}$  and  $R^{15}$  are hydrogen atoms.
- 8 The process according to anyone of claims 1 to 7 wherein the alpha-olefin is 1-pentene, 4-methyl-1-pentene, 1-hexene, 1-octene, 4,6-dimethyl-1-heptene, 1-decene, 1-dodecene, 1-tetradecene, 1-hexadecene, 1-octadecene and 1-eicosene.
- 9 The process according to claim 8 wherein the alpha-olefin is comonomers are - 1-pentene, 1-hexene and 1-octene.
- 10 The process according to anyone of claims 1 to 9 wherein the content of said alpha olefins derived units in the copolymer is from 2% to 20% by mol.
- 11 An isotactic 1-butene copolymer containing up to 30% by mol of one or more alpha-olefins of formula  $CH_2=CHZ$  derived units, wherein Z is a  $C_3$ - $C_{20}$  hydrocarbon group having the following features:
  - isotactic pentads (mmmm) >90%; and
  - the percentage of soluble fraction in diethylether (%SD) and the molar content of said alpha olefins (%O) in the polymer chain meet the following relation:
$$\%SD > 2.8\%O + 8.$$
- 12 The isotactic 1-butene copolymer according to claim 11 wherein the percentage of soluble fraction content in diethylether (%SD) and the molar content of said alpha olefins (%O) in the polymer chain meet the following relation:
 
$$\%SD > 2.8\%O + 10.$$

13. The isotactic 1-butene copolymer according to claims 11 or 12 having a content of alpha-olefin derived units comprised between 10% and 30% by mol and having percentage of soluble fraction in diethylether >92%.
14. The isotactic 1-butene copolymer according to claims 11 or 12 having a content of alpha-olefin derived units comprised between 5% and 12% by mol and having percentage of soluble fraction in diethylether >41%.
15. An isotactic 1-butene copolymer containing up to 30% by mol of units derived from one or more alpha-olefins of formula  $\text{CH}_2=\text{CHZ}$ , wherein Z is a  $\text{C}_3\text{-}\text{C}_{20}$  hydrocarbon group having the following features:
  - isotactic pentads (mmmm) >90%; and
  - presence of 4,1 insertions in the polymer chain.